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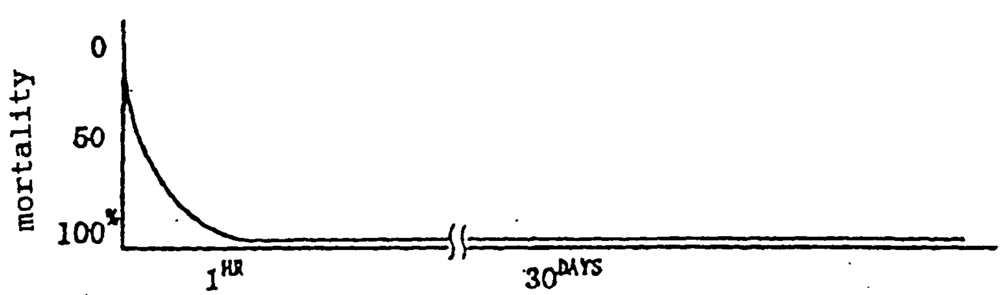
(54) **Antimicrobial composition**

(57) An antimicrobial composition comprises an inorganic metal antimicrobial agent, preferably a zirconium phosphate, a thiazole antimicrobial agent, preferably an isothiazolin-3-one compound, a haloalkylthio antimicrobial agent, preferably a haloalkylthiosulfimide compound, an imidazole antimicrobial agent, preferably a cyclic compound of benzimidazole, and an urea antimicrobial agent, preferably a halophenyl derivative of dimethyl urea, as the essential compounds. The composition exhibits an excellent antimicrobial activity against various kinds of eumycetes, bacteria, actinomycetes, yeast and algae, is excellent in the quickness and persistency of the effect, and is extremely stable in itself.

Fig.1



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Description

Field of Invention

The present invention relates to an antimicrobial composition or mixture, more specifically to a composition exhibiting excellent antimicrobial and antiseptic activities against various kinds of eumycetes, bacteria, actinomycetes, yeast and algae.

Background Art

Antiblastic and antifungal agents have recently been used for the purpose of attaining clean, comfortable and healthy surroundings or for the purpose of inhibiting resources and articles from being deteriorated by microorganisms, and therefore have held an extremely important position in various articles and fields, for example, textiles, timbers, building materials, leathers, adhesives, metal working lubricants, rubbers, plastics, films, paper-pulp industry, cooling water, high-technology industry, electrical machinery and apparatus, optical instruments, air conditioners, stockbreeding, fishery, agriculture, forestry, drugs, agricultural chemicals, water, cosmetics, toiletries, sanitary goods, preservation of food, hospitals, homes for the aged, public institutions, household goods, sporting goods, school supplies, and toys.

Further, such antiblastic and antifungal agents have recently been required not only to be applicable to various fields as described above but also to be efficacious against various kinds of microorganisms. For example, it is expected to develop an antiblastic and antifungal agent capable of inhibiting the growth of all of the 57 kinds of microorganism found in general architecture which were recognized by International Bio-Deterioration Symposium (Philadelphia, U. S.A.) in 1985 (at the sixth meeting held at Emanuel College, U.K.). Further, it is also expected to develop antiblastic, antifungal and antialgal agents capable of inhibiting the growth of not only eumycetes and bacteria but also algae.

In general, various inorganic metal compounds, organometallic compounds, organic compounds and natural products which have been used as antiblastic and antifungal agents each exhibit an inhibitory activity against several to ten or so kinds of microorganism. However, there has not been found any combination of two or more of these compounds which inhibits additional kinds of microorganism beyond their respective inhibitory powers. Further, there were even cases wherein a combination of two or more of the above compounds inhibited only fewer kinds of microorganism than the sum of kinds of microorganism which the compounds could inhibit separately.

Under these circumstances, in JP-A 8-92012, an antimicrobial composition was developed, which comprises a nitrile antimicrobial agent, a pyridine antimicrobial agent, a haloalkylthio antimicrobial agent, an organoiodine antimicrobial agent and a thiazole antimicrobial agent as the active ingredients and exhibits excellent antibacterial, antifungal and antialgal activities by virtue of the additivity and synergism of these agents. However, even this antimicrobial composition was not sufficiently satisfactory in its effect as an antimicrobial agent, such as the kinds of fungi which can be inhibited, quickness expression of antimicrobial power and persistency thereof, and other characteristics for antimicrobial agents, and in the stability of the composition in itself, and so on.

Disclosure of the Invention

The inventors of the present invention have intensively studied to solve the above problems and have found that an antimicrobial composition which can exhibit an excellent antimicrobial activity against various kinds of eumycetes, molds, bacteria, actinomycetes, yeast and algae, be excellent in quickness and persistency of the effect, and have high stability in itself can be obtained by blending together an inorganic metal antimicrobial agent, a thiazole antimicrobial agent, a haloalkylthio antimicrobial agent, an imidazole antimicrobial agent and a urea antimicrobial agent.

Specifically, the present invention relates to an antimicrobial composition characterized by comprising an inorganic metal antimicrobial agent, a thiazole antimicrobial agent, a haloalkylthio antimicrobial agent, an imidazole antimicrobial agent and a urea antimicrobial agent as the essential components.

The present invention provides an antifungal article or material comprising the composition defined above and a carrier.

The present invention provides a process for preventing the growth and activity of microorganisms by applying the composition as defined above to a locus where microorganisms would otherwise grow.

The present invention provides an antimicrobial composition comprising 1 to 96 % by weight of the inorganic metal antimicrobial agent, 1 to 96 % by weight of the thiazole antimicrobial agent, 1 to 96 % by weight of the haloalkylthio antimicrobial agent, 1 to 96 % by weight of the imidazole antimicrobial agent, and 1 to 96 % by weight of the urea antimicrobial agent.

The present invention provides an antimicrobial composition comprising 38 to 58 % by weight of the inorganic metal antimicrobial agent, 1 to 16 % by weight of the thiazole antimicrobial agent, 2 to 22 % by weight of the haloalkylthio antimicrobial agent, 3 to 23 % by weight of the imidazole antimicrobial agent, and 11 to 31 % by weight of the urea

antimicrobial agent.

The antimicrobial composition of the present invention can exhibit an excellent activity against a much larger number of kinds of microorganism such as eumycetes, bacteria, actinomycetes, and yeast than conventional antimicrobial compositions. Further, the composition can exhibit an excellent activity against algae for the first time.

The antimicrobial composition of the present invention can be excellent in persistency of the effect. It can continue to be effective for long periods, even after new bacteria have introduced themselves.

The antimicrobial composition of the present invention exhibits an excellent activity even if the concentration thereof is lower than that of conventional antimicrobial compositions.

The antimicrobial composition comprises plural kinds of antimicrobial agents so that a resistant bacteria may not be produced.

Modes for Carrying Out the Invention

The antimicrobial composition of the present invention will now be described in detail.

The inorganic metal antimicrobial agent to be used for the antimicrobial composition of the present invention includes zeolite antimicrobial agents, zirconium phosphate antimicrobial agents, titania antimicrobial agents, glass antimicrobial agents, silver salts complexes, and so on. Among these agents, zirconium phosphate antimicrobial agents are preferable, zirconium phosphate-silver being particularly preferably used.

The thiazole antimicrobial agent to be used for the composition of the present invention includes isothiazolin-3-one compounds and benzothiazole compounds. Among these compounds, isothiazolin-3-one compounds are preferable.

The isothiazolin-3-one compounds include 1,2-benzisothiazolin-3-one, 2-(n-octyl)-4-isothiazolin-3-one, 5-chloro-2-methyl-4-isothiazolin-3-one, 2-methyl-4-isothiazolin-3-one, and 4,5-dichloro-2-cyclohexyl-4-isothiazolin-3-one. The benzothiazole compounds include 2-(4-thiocyanomethylthio)benzothiazole, 2-mercaptobenzothiazole sodium, and 2-mercaptobenzothiazole zinc. Among them, 1,2-benzisothiazolin-3-one is particularly preferable.

The haloalkylthio antimicrobial agent to be used for the composition of the present invention includes haloalkylthiophthalimide compounds, haloalkylthiotetrahydrophthalimide compounds, haloalkylthiosulfamide compounds, and haloalkylthiosulfimide compounds, among which haloalkylthiosulfimide compounds are preferable.

The haloalkylthiophthalimide compounds include N-fluorodichloromethylthiophthalimide and N-trichloromethylthiophthalimide; the haloalkylthiotetrahydrophthalimide compounds include N-1,1,2,2-tetrachloroethylthiotetrahydrophthalimide and N-trichloromethylthiotetrahydrophthalimide; the haloalkylthiosulfamide compounds include N-trichloromethylthio-N-(phenyl)methylsulfamide, N-trichloromethylthio-N-(4-chlorophenyl)methylsulfamide, N-(1-fluoro-1,1,2,2-tetrachloroethylthio)-N-(phenyl)methylsulfamide, and N-(1,1-difluoro-1,2,2-trichloroethylthio)-N-(phenyl)-methylsulfamide; and the haloalkylthiosulfimide compounds include N,N-dimethyl-N'-phenyl-N'-(fluorodichloromethylthio)sulfimide, N,N-dichlorofluoromethylthio-N'-phenylsulfimide, and N,N-dimethyl-N'-(p-tolyl)-N'-(fluorodichloromethylthio)sulfimide. Among these compounds, N,N-dimethyl-N'-phenyl-N'-(fluorodichloromethylthio)-sulfimide is particularly preferable.

The imidazole antimicrobial agent to be used for the composition of the present invention includes benzimidazolecarbamic acid compounds, sulfur-containing benzimidazole compounds, and cyclic compounds of benzimidazole, among which cyclic compounds of benzimidazole are preferable.

The benzimidazolecarbamic acid compounds include methyl 2-benzimidazolecarbamate, methyl 1-butylcarbamoyl-2-benzimidazolecarbamate, methyl 6-benzoyl-2-benzimidazolecarbamate, and methyl 6-(2-thiophenecarbonyl)-2-benzimidazolecarbamate.

The sulfur-containing benzimidazole compounds include 2-thiocyanomethylthiobenzimidazole and 1-dimethylaminosulfonyl-2-cyano-4-bromo-6-trifluoromethylbenzimidazole.

The cyclic compounds of benzimidazole or benzimidazole compounds being substituted with another cyclic compound include 2-(4-thiazolyl)benzimidazole, 2-(2-chlorophenyl)-benzimidazole, 2-(1-(3,5-dimethylpyrazolyl))benzimidazole, and 2-(2-furyl)benzimidazole.

Among these compounds, 2-(4-thiazolyl)-benzimidazole is particularly preferable.

The urea antimicrobial agent to be used for the composition of the present invention includes halophenyl derivatives of dimethylurea, among which 3-(3,4-dichlorophenyl)-1,1-dimethylurea is preferable.

All of the above compounds are well-known ones and can readily be prepared by conventional processes. Further, many of them are commercially available, and such commercially available ones can also be used in the present invention.

The antimicrobial composition of the present invention can be prepared by mixing the above components together in suitable amounts, and the preferable amount of the composition to be added is 0.06 to 0.2% by weight based on the object of an article.

The form of the antimicrobial composition of the present invention is not particularly limited, but the composition may take various forms including water-based, powdery and solvent-based ones. That is, the above components are

converted into a desirable form by the use of optional components generally used for the form, and applied to various articles and in various fields, for example, textiles, timber, building materials, leathers, adhesives, metal working lubricants, rubbers, plastics, films, paper-pulp industry, cooling water, high-technology industry, electrical machinery and apparatus, optical instruments, air conditioners, stockbreeding, fishery, agriculture, forestry, drugs, agricultural chemicals, water, cosmetics, toiletries, sanitary goods, preservation of food, hospitals. homes for the aged, public institutions, household goods, sporting goods, school supplies, and toys.

The antimicrobial composition of the present invention is efficacious against various kinds of eumycetes, bacteria, actinomycetes, yeast and algae, specifically against not only 57 kinds of microorganism found in general architecture which were recognized by International Bio-Deterioration Symposium (Philadelphia, U.S.A.), but also other microorganisms. Further, the composition has advantageous effects, thought to be by virtue of the combination of inorganic and organic antimicrobial agents in that the antimicrobial spectrum can be extremely broad, that the composition can be extremely quick in its effect, and that the effect can persist for a long time.

The antimicrobial composition of the present invention can be extremely stable in itself, and therefore can have the following characteristics: ① the composition is free from lowering of activity or environmental pollution caused by the dissolution or volatilization of antimicrobial agents, because it comprises both an inorganic antimicrobial agent insoluble in aqueous media or organic solvents and organic antimicrobial agents insoluble in aqueous media; ② when the composition is incorporated into a plastic, film, sheet, cloth or synthetic paper, there occurs little change in the properties in heating for molding or processing, so that the resulting product suffers little from yellowing or lowering in the transparency; and ③ when the composition is incorporated into a synthetic fiber, the resulting fiber is not affected by washing with an anionic detergent or the like.

Further, the antimicrobial composition of the present invention can be free from reductive discoloration which is one of the disadvantages of inorganic antimicrobial compositions, and is effective over a wide pH range. Further, the composition can be composed of chemicals registered as the existing chemical substances stipulated by the Ministry of International Trade and Industry and is therefore not problematic in safety.

Brief Explanation of the Drawing

Fig. 1 is a graph showing the mortality of Escherichia coli as observed in Example 2 wherein an antimicrobial composition of the present invention was used.

Examples

The present invention will now be described in detail by referring to the following Examples, though the present invention is not limited to them.

Example 1

An antimicrobial composition was prepared by mixing together zirconium phosphate-silver as the inorganic metal antimicrobial agent, 1,2-benzisothiazolin-3-one as the thiazole antimicrobial agent, N,N-dimethyl-N'-phenyl-N'-(fluorodichloromethylthio)sulfimide as the haloalkylthio antimicrobial agent, 2-(4-thiazolyl)benzimidazole as the imidazole antimicrobial agent and 3-(3,4-dichlorophenyl)-1,1-dimethylurea as the urea antimicrobial agent in suitable amounts. An experiment was conducted to determine the minimum concentrations (ppm) of the antimicrobial composition at which the growth of the kinds of microorganism which will be listed (including 57 kinds of microorganism found in common buildings or living circumstances which were recognized by International Bio-Deterioration Symposium) was inhibited. More precisely, potato-agar media, Sabouraud's agar media and sucrose-agar media containing the above antimicrobial composition in various concentrations were prepared and test microorganisms of each kind prepared by single cell culture were planted on the media. The resulting media were kept in an incubator at 30°C and a relative humidity of 95% for 7 days. The lowest concentration of the antimicrobial composition at which the test microorganisms did not grow was taken as the minimal inhibitory concentration (MIC value). MIC is a concentration per the medium. The MIC values of the kinds of microorganism thus determined are as follows.

microorganisms having the MIC values of less than 1 ppm	
Tribonema sp.	Algae
Anacystis nidulans	Algae
Penicillium frequentance	Mold
Penicillium citrinum	Mold

(continued)

microorganisms having the MIC values of less than 1 ppm	
Fusarium semitectum	Mold
Alternaria alternata	Mold
Eurotium tonophilum	Mold
Penicilium variable	Mold
Penicilium Purpurogenum	Mold
Aspergillus awamori	Mold
Blastomyces dermatidis	Yeast
Dactylium dendroides	Mold
Medurella mycetomii	Mold
Microsporum canis	Mold
Blastomyces italicum	Yeast
Rhizoctonia Violacea	Bacteria
Cerespora beticola	Mold
Cerespora musao	Mold
Claviceps purpurea	Mold
Colletotrichum trifolii	Mold
Penicillium glaucum	Mold
Pullularia pullulans	Mold
Trichophyton mentagrophytes	Mold
Botrytis cinerea	Mold
Endothia paracitica	Bacteria
Sclerotina sclerotiorum	Bacteria
Venturia inaequalis	Bacteria
Penicillium roqueforti	Mold
Monilia laxa	Mold
Monilia fructigana	Mold
Lenzites trabea	Mold
Ceratocystis sp.	Mold
Diplodia viticola	Bacteria
Neurospora sitophilia	Mold
Oidium sp.	Mold

microorganisms having the MIC values of at least 1 ppm and less than 10 ppm	
Aspergillus niger	Mold
Aspergillus oryzae	Mold
Aspergillus flavus	Mold
Aspergillus versicolor	Mold
Aspergillus fumigatus	Mold
Aspergillus nidulans	Mold
Aspergillus glaucus	Mold
Aspergillus terreus	Mold
Aspergillus phoenicus	Mold
Aspergillus tamari	Mold
Aspergillus wentii	Mold
Aspergillus restrictus	Mold
Aspergillus ochraceous	Mold
Chaetomium clivaceum	Mold
Chaetomium globosum	Mold

(continued)

microorganisms having the MIC values of at least 1 ppm and less than 10 ppm	
Cladosporium cladosporioides	Mold
Cladosporium sphaerospermum	Mold
Cladosporium herbarum	Mold
Bacillus cercus	Bacteria
Vibreo perahaemolyticus	Bacteria
Ascophyta pisi	Bacteria
Rhizoctonia solani	Bacteria
Alternaria pisi	Mold
Alternaria candidus	Mold
Trichophyton gypseum	Mold
Trichophyton rubrum	Mold
Penicillium luteum	Mold
Penicillium expansum	Mold
Phomosis citri	Mold
Diplodia natalensis	Mold
Fusarium oxysporum	Mold
Penicillium chrysogenum	Mold
Venticillium albo-atrum	Mold
Ustilago zeae	Mold
Penicillium citreo-viride	Mold
Oscillatoria aurea	Algae
Stichococcus bacillavis	Mold
Pestalotia neglecta	Mold
Fusarium roseum	Mold
Alternaria brassicicola	Mold
Geotrichum candidum	Mold
Geotrichum lactus	Mold
Gliocladium vireus	Mold
Phacidipycnus funfuracea	Mold
Phymatotricum omnivorum	Mold
Sclerotina fructincola	Mold
Aureobasidium pullulans	Mold
Fusarium solani	Mold
Penicillium notatum	Mold
Penicillium rubrum	Mold
Trichothecium roseum	Mold
Lenzites trabae	Mold
Monilia nigra	Mold
Microsporum audouini	Mold
Penicillium cyclopium	Mold
Colletotrichum lindemuthianum	Mold
Ceratocystis ulmi	Mold
Phoma terrestrius	Mold
Candida albicans	Yeast
Microsporum gypseum	Mold
Penicillium oxalicum	Mold
Penicillium spinulosum	Mold
Penicillium funiculosum	Mold
Penicillium digitatum	Mold

(continued)

microorganisms having the MIC values of at least 1 ppm and less than 10 ppm	
Fusarium roseum	Mold
Schizothrix sp.	Algae
Hormidium sp.	Algae
Ulothlichaceac sp.	Algac

microorganisms having the MIC values of at least 10 ppm and less than 20 ppm	
Candida acutus	Yeast
Phaffia rhodozyma	Bacteria
Sporobolomyces roseus	Yeast
Pichia anomala	Bacteria
Pichia membranaefaciens	Bacteria
Zygosaccharomyces rouxii	Yeast
Zygosaccharomyces bailii	Yeast
Rhodotorula gulinis	Mold
Rhodotorula lactosa	Mold
Streptococcus lactis	Bacteria
Aerobacter aerogenes	Mold
Clostridium acetobutylicum	Mold
Clostridium sporogenes	Mold
Campylabacter jejuni	Bacteria
Cryptococcus lutealus	Mold
Schizosaccharomyces pombe	Yeast
Saccharomycodes ludwigii	Bacteria
Saccharomycodes pasteurianus	Mold
Pichia membranaefaciens	Mold
Debaryamyces hansenii	Bacteria
Hansemula anomala	Bacteria
Kloeckera apiculata	Bacteria
Candida utilis	Yeast
Aspergillus luchensis	Mold
Penicillium islandicum	Mold
Trichophyton ajelloi	Mold
Cryptococcus neoformans	Mold
Helminthosporium sp.	Mold
Rhizopus nigricans	Mold
Rhizopus oryzae	Mold
Hormoderdrum pedrosoi	Mold
Mucor racemosus	Mold
Sporotrichum schenckii	Mold
Stachybotrys sp.	Mold
Chlorella vulgaires	Algae
Epicoccum purpurascens	Mold
Pestalotia adusta	Mold
Penicillium nigricans	Mold
Penicillium lilacinum	Mold
Phoma glomerata	Mold
Paecilomyces lilacinus	Yeast
Cladosporium resinae	Mold

(continued)

microorganisms having the MIC values of at least 10 ppm and less than 20 ppm	
Gluconobacter suboxydans	Bacteria
Serratia marcesens	Bacteria
Micrococcus glatamicus	Bacteria
Streptococcus faecalis	Bacteria
Streptococcus thermophilus	Bacteria
Podiococcus soyae	Bacteria
Podiococcus acidilactici	Bacteria
Lactobacillus acidophilus	Bacteria
Lactobacillus plantarum	Bacteria
Autotrophic bacteria	Bacteria
Streptomyces griseus	Actinomycetes
Streptomyces aureofaciens	Actinomycetes
Streptomyces kasugaensis	Actinomycetes
Acuremonium charticola	Mold
Chlorococcum sp.	Algae
Oscilatoria sp.	Algae

microorganisms having the MIC values of at least 20 ppm and less than 30 ppm	
Anabana sp.	Algae
Cladophora glomerata	Algae
Ankistrodemus angustus	Algae
Chlamydomonas reinhardii	Algae
Trentephohlia odarata	Algae
Alternaria tenuis	Mold
Cryptococcus albidas	Mold
Paecilomyces variotti	Yeast
Fusarium proliferatum	Mold
Anacystis sp.	Algae
Chlorella emersonii	Algae

microorganisms having the MIC values of at least 30 ppm and less than 50 ppm	
Rhizopus storonifer	Mold
Escherichia coli	Bacteria
Staphylococcus aureus	Bacteria
Pseudomonas aeruginosa	Bacteria
Salmonella typhimurium	Bacteria
Legionella pneamophila	Bacteria
Leptospira interrogans	Bacteria
Rickettsia rickettsii	Bacteria
Mycobacterium tubercolosis	Bacteria
Proteus mirabilis	Bacteria
Proteus vulgaris	Bacteria
Staphylococcus epidermidis	Bacteria
Micrococcus candidus	Bacteria
Bacillus mycoides	Bacteria
Pseudomonas fluresceus	Bacteria

(continued)

microorganisms having the MIC values of at least 30 ppm and less than 50 ppm	
Bacillus subtillis	Bacteria
Bacillus megaterium	Bacteria
Streptoverticillum reticulum	Bacteria
Nigrospora oryazac	Mold
Trichoderma koningii	Mold
Trichoderma T-1	Mold
Trichoderma viride	Mold
Fusarium moniliforme	Mold
Myrothecium verrucaria	Mold
Streptococcus faecalis	Bacteria
Salmonella enteritidis	Bacteria
Pseudomonas flourescens	Bacteria
Salmonella enterrica	Bacteria
Salmonella arizonae	Bacteria
Salmonella paratyphi	Bacteria
Salmonella choleraesuis	Bacteria
Campylobacter fetus	Bacteria
Streptococcus agalactiae	Bacteria
Serratia marcesceus	Bacteria
Serratia liguefaciens	Bactoria
Klebsiella oxytoca	Bacteria
Clostridium perfringens	Bacteria
Clostridium diffcile	Bacteria
Bacillus anthracis	Bacteria
Vibrio fluvialis	Bacteria
Vibrio mimicus	Bacteria
Vibrio ulnificus	Bacteria
Vibrio omma	Bacteria
Mucor mucedo	Mold
Mucor pusillus	Mold
Rhyzopus delemar	Mold
Absidia glauca	Mold
Pleurococcus sp.	Algae
Scytonema hofmannii	Algae

microorganisms having the MIC values of at least 50 ppm and less than 70 ppm	
Wallemia sebi	Mold
Saccharomyces cerevisiae	Yeast
Klebsiella pneumoniae	Bacteria
Bacillus punctatum	Bacteria
Bacterium vulgaro	Bacteria
Bacterium pyocyaneum	Bacteria
Thio bacilus sp.	Bacteria
Fusarium nivale	Mold
Fusarium avenaceum	Mold
Fusarium acuminatum	Mold
Pythium vanterpoolii	Bacteria
Phyrarium cinereum	Bacteria

(continued)

microorganisms having the MIC values of at least 50 ppm and less than 70 ppm	
Aster yellows	Bacteria
Sugeran mosaic	Bacteria
Corticium fuciforme	Bacteria
Lepiota criststa	Bacteria
Lepiota castanae	Bacteria
Mesotaenium	Algae
Zygogonium	Algae
Trentephohlia aurea	Algae

Example 2

The mortality of the antimicrobial composition used in Example 1 was determined by the use of Escherichia coli. Specifically, 4.6 x 10^6 of Escherichia coli was prepared and transplanted to a test piece made of polypropylene containing 0.1% by weight of the antimicrobial composition described above, placed on a medium for the culture of Escherichia coli. The resulting system was cultured in a circulator (temp: 37°C, humidity: 95%) to determine the mortality. The results are shown in Fig. 1. It can be understood from the results shown in Fig. 1 that the antimicrobial composition of the present invention can destroy most (at least 99 %) of Escherichia coli only in one hour and the effect can persist for 40 days or more without any change.

Example 3

The antiblastic test of the antimicrobial composition of the present invention used in Example 1 was determined by the use of Staphylococcus aureus as the test microorganism. Specifically, 1.1 x 10^6 of Staphylococcus aureus was prepared and transplanted to a test sample placed on a medium for the culture of Pseudomonas aeruginosa, and the resulting system was cultured in a circulator (temp: 37°C, humidity: 95%). The viable count was determined after 1, 24 and 48 hours and 30 days. The test samples used were test piece (Invention) produced by injection-molding a polypropylene containing 0.1% by weight of the antimicrobial composition used in Example 1 and test piece produced by injection-molding a polypropylene, being free from the antimicrobial composition. The results are given in Table 1.

Table 1

	Viable count after one hour	Viable count after 24 hours	Viable count after 48 hours	Viable count after 30 days
Compn.-free piece	3.7×10^7	4.1×10^8	5.0×10^8	5.5×10^8
Invention	4.3×10^3	3.6×10^3	2.8×10^3	1.1×10^2

Example 4

The antimicrobial composition of the present invention used in Example 1 was examined for antifungal fungiagainst. Specifically, a test solution containing 10^6 of 15 kinds of eumycetes was prepared and sprayed on a test sample placed on a Sabouraud's agar media (wet method). The resulting system was cultured in a circulator (temp: 28°C±5°C, humidity: 90%±10%) to determine the fungal growth. The test samples used were test piece (Invention) produced by injection-molding a polypropylene containing 0.1% by weight of the antimicrobial composition used in Example 1 and test piece produced by injection-molding a polypropylene, being free from the antimicrobial composition. The results of exsistence of the fungal growth observed after 10, 20 and 40 days are given in Table 2, wherein the symbol "+" means a case wherein fungi grew, and the symbol "-" a case wherein fungi did not grow.

Table 2

	after 10 days	after 20 days	after 40 days
Compn.-free piece	+	+	+
Invention	-	-	-

Example 5

1)Preparation of an antimicrobial composition

An antimicrobial composition was prepared by mixing the five kinds of antimicrobial agent described in the following Table 3.

Table 3

kind of antimicrobial agent	name of compound	content (wt.%)
inorganic metal	zirconium phosphate-silver	48
thiazole	1,2-benzisothiazolin-3-one	6
haloalkylthio	N,N-dimethyl-N'-phenyl-N'-(fluorodichloromethylthio)-sulfimide	12
imidazole	2-(4-thiazolyl)benzimidazole	13
urea	3-(3,4-dichlorophenyl)-1,1-dimethylurea	21

2)Preparation of a test solution

The above antimicrobial composition was suspended in a sterilized saline solution in an amount of 1%. It was used as the test solution. Another sterilized saline solution, being free from the antimicrobial composition, was used as a control.

3)Preparation of a solution of fungi

Staphylococcus aureus IID 1677 resistance to methicillin (MRSA) was used as the test fungi. MRSA was shaked and cultured at 35°C in 20 hours on an NB medium prepared by adding 0.2% of meat extract to a broth medium, produced by Eiken Kagaku. The cultured medium was diluted 200 times by a sterilized phosphate-buffered saline solution. It was used as the solution of fungi.

4)Antimicrobial activity experiment

1 ml of the solution of fungi was added to 100 ml of the test solution and the control, and mixed. The resulting system was allowed to store at 25 °C for 24 hours. The number of living strains was determined by drawing two lines in parallel of the bacteria with a platinum needle at 35°C for 2days using SCDLPA agar media produced by Nihon Seiyaku. The results are shown in Table 4. It was confirmed that, with 1 ml of the test solution diluted as ten times, the number of living strains could be determined by a preliminary test.

Table 4

fungus		the living number (/ml)	
		starting time*	after 24 hours
MRSA	test solution	1.2×10^5	<10
	control	1.2×10^5	3.0×10^3

"<10" means no detection.

*:The number of living strains (viable count) was determined in the control just after addition of the solution of fungi. This is the value of the starting time.

Example 6

1)Preparation of an antimicrobial composition

The antimicrobial composition prepared in Example 5 was used.

2)Preparation of a test solution

The test solution was prepared in the same manner as in Example 5, except that a sterilized purified water was used instead of a sterilized saline solution.

3)Preparation of a solution of fungi

Escherichia coli ATCC 43895 (colibacilli, serotype O157:H7, species to produce Vero toxin I, II) was used as the test fungi. The solution of fungi was prepared in the same manner as in Example 5, except that a sterilized phosphate buffer was used instead of a sterilized phosphate-buffered saline solution.

4)Antimicrobial activity experiment

The antimicrobial activity experiment was carried out in the same manner as in Example 5. The results are shown in Table 5. It was confirmed that, with 1 ml of the test solution diluted as ten times, the number of living strains could be determined by a preliminary test.

Table 5

fungus		the living number (/ml)	
		starting time*	after 24 hours
colibacilli O157:H7	test solution	3.0×10^5	<10
	control	3.0×10^5	3.4×10^5

"<10" means no detection.

*:The number of living strains was determined in the control just after addition of the solution of fungi. This is the value of the starting time.

Claims

1. An antimicrobial composition comprising an inorganic metal antimicrobial agent, a thiazole antimicrobial agent, a haloalkylthio antimicrobial agent, an imidazole antimicrobial agent, and an urea antimicrobial agent.

2. A composition as claimed in claim 1, wherein the inorganic metal antimicrobial agent is selected from zeolite antimicrobial agents, zirconium phosphate antimicrobial agents, titania antimicrobial agents, glass antimicrobial agents, and silver salts complexes.

3. A composition as claimed in claim 2, wherein the inorganic metal antimicrobial agent is a zirconium phosphate antimicrobial agent.

4. A composition as claimed in any of claims 1 to 3, wherein the thiazole antimicrobial agent is selected from isothiazolin-3-one compounds and benzothiazole compounds.

5. A composition as claimed in claim 4, wherein the thiazole antimicrobial agent is an isothiazolin-3-one compound.

6. A composition as claimed in any of claims 1 to 5, wherein the haloalkylthio antimicrobial agent is selected from haloalkylthiophthalimide compounds, haloalkylthiotetrahydrophthalimide compounds, haloalkylthiosulfamide compounds, and haloalkylthiosulfimide compounds.

7. A composition as claimed in claim 6, wherein the haloalkylthio antimicrobial agent is a haloalkylthiosulfimide compound.

8. A composition as claimed in any of claims 1 to 7, wherein the imidazole antimicrobial agent is selected from benzimidazolecarbamic acid compounds, sulfur-containing benzimidazole compounds, and cyclic compounds of benzimidazole.

9. A composition as claimed in claim 8, wherein the imidazole antimicrobial agent is a cyclic compound of benzimidazole.

10. A composition as claimed in any of claims 1 to 9, wherein the urea antimicrobial agent is a halophenyl derivative of dimethylurea.

11. A composition as claimed in claim 1, wherein the inorganic metal antimicrobial agent, the thiazole antimicrobial

agent, the haloalkylthio antimicrobial agent, the imidazole antimicrobial agent, and the urea antimicrobial agent are a zirconium phosphate antimicrobial agent, an isothiazolin-3-one compound, a haloalkylthiosulfimide compound, a cyclic compound of benzimidazole, and a halophenyl derivative of dimethylurea, respectively.

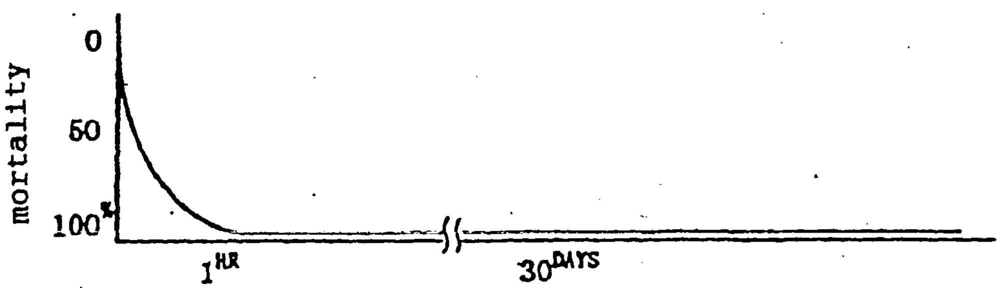
12. A composition as claimed in any of claims 1 to 11, comprising 1 to 96 % by weight of the inorganic metal antimicrobial agent, 1 to 96 % by weight of the thiazole antimicrobial agent, 1 to 96 % by weight of the haloalkylthio antimicrobial agent, 1 to 96 % by weight of the imidazole antimicrobial agent, and 1 to 96 % by weight of the urea antimicrobial agent.

13. A composition as claimed in claim 12, comprising 38 to 58 % by weight of the inorganic metal antimicrobial agent, 1 to 16 % by weight of the thiazole antimicrobial agent, 2 to 22 % by weight of the haloalkylthio antimicrobial agent, 3 to 23 % by weight of the imidazole antimicrobial agent, and 11 to 31 % by weight of the urea antimicrobial agent.

14. An antifungal article comprising a composition as claimed in any of claims 1 to 13 and a carrier.

15. A process for preventing the growth and activity of microorganisms by applying the composition as claimed in any of claims 1 to 13 to a locus where microorganisms would otherwise grow.

Fig.1



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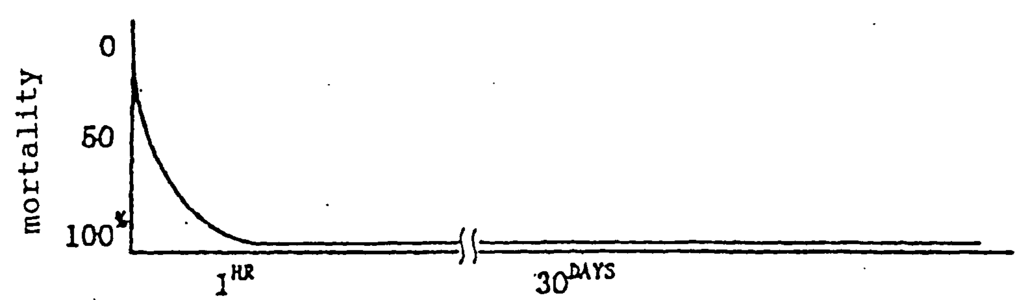
(54) **Antimicrobial composition**

(57) An antimicrobial composition comprises an inorganic metal antimicrobial agent, preferably a zirconium phosphate, a thiazole antimicrobial agent, preferably an isothiazolin-3-one compound, a haloalkylthio antimicrobial agent, preferably a haloalkylthiosulfimide compound, an imidazole antimicrobial agent, preferably a cyclic compound of benzimidazole, and an urea antimicrobial agent, preferably a halophenyl derivative of dimethyl urea, as the essential compounds. The composition exhibits an excellent antimicrobial activity against various kinds of eumycetes, bacteria, actinomycetes, yeast and algae, is excellent in the quickness and persistency of the effect, and is extremely stable in itself.

Fig.1



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EUROPEAN SEARCH REPORT

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	15 July 1998	Klaver, J

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DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
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Y	US 4 008 351 A (INOUE MAYUMI ET AL) 15 February 1977 * the whole document *	1-15	TECHNICAL FIELDS SEARCHED (Int.Cl.6)

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